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Date: December 7, 1999  
Re: Inventor(s): Jose Villena, Jeffrey Stout, Eyal Ben-Chanoch,  
and Herrick Gooden  
Title: **NON-BLOCKING EXPANDABLE CALL  
CENTER ARCHITECTURE**  
Atty. Docket No.: 233/1



Box NEW APP. FEE  
Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Submitted herewith is the above-identified patent application. Also enclosed are:

- 1) 3 sheets of informal drawings (Figs. 1-3);
- 2) A self-addressed, stamped return postcard; and
- 3) A check in the amount of \$380.00 payable to the "Commissioner of Patents and Trademarks."

Respectfully submitted,

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Enclosures

**CERTIFICATE OF MAILING**

Express Mail mailing label number EL069665552US  
Date of Deposit December 7, 1999

I hereby certify that this paper or fee is being deposited with the United States Postal Service Express Mail Post Office to Addressee service under 37 C.F.R. §1.10 on the date indicated above and is addressed to Box NEW APP. FEE, Assistant Commissioner for Patents, Washington, D.C. 20231.

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# **NON-BLOCKING EXPANDABLE CALL CENTER ARCHITECTURE**

## **TECHNICAL FIELD**

This invention relates to call centers, and in a more general sense, contact centers for  
5 customer interface via telephone, and other media, with a plurality of agents at the contact center.

## **BACKGROUND OF THE INVENTION**

Most large corporations implement contact centers, an arrangement whereby customers may  
call in with questions regarding accounts, complaints, or other issues. A typical example of such a  
10 contact center might be a credit card company, which maintains a plurality of agents at one or more  
locations to handle customer inquiries, account questions, etc. Recently, these call centers may be  
more generally referred to as contact centers, since the agent customer interaction may not be limited  
telephone calls. Rather, agent customer interaction may include items such as web chat, e-mail, or  
other forms of interaction between an agent and a customer.

Fig. 1 shows a conventional prior art legacy call center configuration. The arrangement  
includes a variety of distinct components that are usually patched together in order to provide the  
15 required services. The arrangement of Fig. 1 includes various reporting capabilities, different servers  
and gateways, and a variety of agents, all connected to a PBX. It also includes independent,  
disparate voice processing applications, such as voice mail and fax servers.

20 A variety of problems are present with respect to such prior art systems. First, the ability to  
grow the system is extremely limited. As more lines are required, more PBXs must be added. The  
PBXs must then be connected to all of the other PBXs. If four PBXs are to be used, for example,  
then each of the PBXs must be connected to three other PBXs. This creates a complicated system

which cannot be efficiently or easily expanded. The switching capacity of each PBX is used up largely to connect to other PBXs rather than to perform switching of contacts for servicing.

Another problem with such legacy prior art systems is that of fault tolerance, if fault tolerance is even available at all. Specifically, a typical manner in which fault tolerance is implemented at such systems is to run a ghosting processor for every critical system. If a particular system element requires fault tolerance, then two of those elements must be run constantly, with one acting as a hot spare. This also causes a tremendous amount of excess cost to be introduced into the system.

Still another problem with prior art systems is that the switching capacity of the PBX is typically not enough to insure a non-blocking system. Specifically, in prior art systems, the main interface from the call center to the public switched telephone network (PSTN) is typically a PBX. The PBX is configured to have a switching capacity based upon the expected statistics regarding call volume and services requested. As a result, it is possible that an agent, voice mail, IVR or other system resource may be available, but a caller may nonetheless be blocked because the system has run out of switching capacity in order to connect the available resource to the caller. In such a situation, the caller is frustrated and the call center operator may lose business.

In view of the above, there exists a need in the art for a more flexible and expandable call center architecture.

There also exists a need in the art for a call center which can provide back-up of critical resources without having to recreate every resource twice.

There also exists a need in the art for a system which can be easily expanded by adding resources without having to reconfigure the entire system.

## **SUMMARY OF THE INVENTION**

The above and other problems of the prior art are overcome in accordance with the present invention which relates to an easily expandable call center environment with fault tolerance. One or more chassis are utilized which each include switching capacity for connecting callers to a variety of call center resources. Additionally, each chassis contains one or more conference bridges for allowing call supervision, conferencing, etc. In the case of plural chassis, they are interconnected via a broadband network such as ATM, etc. One or more additional chassis is also provided for back-up of all other chassis. If any of the plural chassis fails, the back-up may be utilized by rerouting calls through it to any other resource or agent in the call center.

Additionally, the chassis are interconnected in a manner that reserves bandwidth from the broadband network for such interconnection, rather than switching capacity of each chassis. Accordingly, the capacity of the call center is linearly expandable, and does not require the switching resources of the PBX in order to connect to other PBXs for expansion.

In an additional enhanced embodiment, the switching and resource platform may be configured in a hybrid manner that allows for a combination of narrowband/broadband operation. Specifically, the switching/resource platform may connect to call center agents partially through an existing PBX with permanent connections to the call center agents, and partially over a broadband communications network such as an Ethernet or ATM switch. By providing such hybrid operation, existing technology can be utilized and can be phased out as the system is grown and expanded. The functionality implemented by connecting the agent stations to the switching and resource platform 210 is the same, irrespective of whether such connection is through the PBX 301 or LAN 208. The switching and resource platform 210 may be implemented as the CCPRO product, available from

the assignee of the present invention.

A more complete understanding of the present invention may be had by referring to the annexed drawings and following description of the invention.

## 5 **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 depicts a prior art legacy call center configuration;

Fig. 2 shows an exemplary configuration of the present invention wherein a switching arrangement is connected to various agents and servers via a broadband switching arrangement instead of a PBX; and

Fig. 3 depicts an environment in which a switching arrangement is connected to various agents through a PBX and to additional agents through a separate network such as a ATM or Ethernet.

## **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Fig. 2 shows an exemplary arrangement for implementing the present invention in what is termed a broadband configuration. The arrangement of Fig. 2 includes one or more database servers 202 and application servers 203, agent stations 204 (only one of which is shown), and supervisory and management functions 205 and 206. The various computer systems are interconnected via a broadband communications network such as an Ethernet or ATM network 208. Any other type of network is possible as well. The incoming and outgoing contacts, both PSTN and Internet, are handled by two CCPRO switches, each of which interfaces to the network 208 via interface 214 and 215, respectively. The CCPRO switches are available from the assignee of the present invention and

may operate in place of, or in conjunction with, a PBX. Each CCPRO switch is resident within one chassis, and includes plural boards to implement the switching capacity.

The particular chassis within which the switch 210 or 211 resides includes four potential points of interface for information to enter or exit the chassis. First, there are incoming trunks (which may be Internet telephony or PSTN as shown), the number of which is denoted herein T.

Second, each switching chassis is responsible for handling a number S of agent stations, one of which is shown as 204. Third, the CCPRO switch chassis includes call processing resources of its own such as a conference bridge. Each resource might have to be connected to something else. If R is the number of such other resources, this represents, worst case, R points of interface.

Finally, there are a number B of broadband connections reserved for connecting the chassis to other chassis such that switches 210 and 211 may communicate with one another. The number B represents only the broadband connections utilized to interconnect the switches, and does not include other communications over the broadband network.

The preferred strategy is to insure that there is enough switching capacity within the CCPRO chassis to insure that if any agent or other desired resource is available, a caller can be connected to that agent or resource. Moreover, the system should insure that the resources managed by and connected to any switch chassis 210, 211 or others can be used interchangeably by agents and callers connected to other chassis.

In order to insure such a technique, B, the number of connections used to interconnect the chassis to each other must be set at an appropriate level. Specifically, in the worst case scenario, every one of the trunks T and stations S may need to be simultaneously in communication via the broadband connections B to another chassis. This means in the worst case scenario,  $B \geq T + S$ .

Moreover, the switching arrangement is implemented within the chassis in a conventional fashion using time division multiplexing (TDM). It can be shown that in order to insure that no available connection is blocked because of lack of switching capacity, the number of time slots required within the switch is  $T + S + R + B$ , with resources R including conference, recording, and playback resources. By setting the time slots appropriately or, alternately, setting T, S, R, and B appropriately for a given number of timeslots, no blocking will occur and the system will be linearly expandable.

By linearly expandable we mean that the switching channels present in an added CCPRO switch chassis may all be utilized for call switching. This is in contrast to prior systems in which much of the switching capacity has to be utilized to interface to other PBXs, particularly as the number of PBXs increases.

Fig. 3 shows an additional embodiment of the present invention wherein like components have been labeled with similar numbers. The embodiment of Fig. 3 includes an additional component 301 which may be a legacy type of PBX.

As shown in Fig. 3, a plurality of connections to agent phones 303 and 304 may be connected to the CCPRO switch chassis 210 through the legacy PBX. This permits a company already utilizing a legacy call center architecture to add the CCPRO chassis without discarding their old equipment or redesigning their entire architecture.

In operation, the CCPRO switch would dial up the agents 303 and 304 through extensions on a PBX and leave such connections permanently in place. This dial up connection through the PBX is accomplished by having the CCPRO switch call the agent through the PBX in response to the agent logging into the CCPRO system. Notably, although only two agents are shown, many other blended agents may be connected to network 208 and may communicate with the switch not through

the PBX 301 but directly through the broadband network 208. Accordingly, a hybrid upgrade configuration is established whereby of a plurality of agents, several of the agents may communicate with the CCPRO switch via the PBX, and several may communicate with the switch via network 208. Ideally, the customer may begin utilizing the system by establishing all of the connections to its agents through the PBX 301. As capacity expands and the PBX contains no further ports, further connections from the chassis 210 or other chassis 211, etc., may be done directly through the broadband network 208. Alternatively, all contacts to and from the CCPRO switch, both inbound and outbound and regardless of media type, may be completed by connecting agents through the PBX on a permanent basis by having the CCPRO switch 210 dial up the agents through PBX 301. All of the agent terminals may be connected to the CCPRO switch 210 notwithstanding the LAN 208 that interconnects the agent terminals and the CCPRO switch. The CCPRO switch would maintain its connections to the agents while performing its telephony functions such as hold, transfer, conference, record, and other similar voice processing functions.

An additional advantageous feature of the present architecture is the implementation of N+1 redundancy among call center switches. Specifically, Fig. 3 shows exemplary switches 210 and 211 in separate chassis. In actuality, the system is linearly growable so that capacity may be added simply by adding more trunks and more of such chassis 210 and 211.

Rather than constantly run a "hot spare," for each component, the system achieves redundancy and back-up in a manner that only requires one additional chassis and switch for all of the switches running in the system. Specifically, an exemplary system may run five or six different CCPRO switches such as those depicted as 210 and 211. Since the system has reserved enough bandwidth for any switch to communicate with the agents and other resources of any other switch,



any of the CCPRO switches can service the capacity of any of the other ones. Accordingly, if there are five in the system, a sixth may be used as a hot spare to back-up any of the five operating switches which fails. In accordance with such a technique, if, for example, CCPRO switch 210 fails, the PSTN and Internet networks 307 and 308 would detect such failure and automatically route trunks destined originally for 210 to an additional and different N+1 redundant switch installed for the purpose of fault tolerance.

It is possible to use more back-up CCPRO switches (e.g., M) to obtain more reliable redundancy, but the N + M redundancy architecture eliminates the need for a hot spare with respect to each CCPRO switch. That is, M may be less than N, and the smaller M is, the less fault tolerance but the more savings, M could be one and still provide back-up.

While the foregoing describes the preferred embodiment of the invention, various modifications and/or additions will be apparent to those skill in the art. Such modifications are intended to be covered by the following claims.

## **WHAT IS CLAIMED:**

1. A contact center comprising:

a local area network;

a first switching apparatus for connecting to at least one public network, the switching  
5 apparatus being configured to communicate over the local area network; and

a plurality of contact center resources for processing and servicing said contacts, a first subset  
of the contact center resources being configured to interface with the switching apparatus via the  
local area network, and a second subset of said contact center resources being configured to interface  
with the switching apparatus via a Private Branch Exchange (PBX).

2. The contact center of claim 1 wherein a plurality of said first switching apparatus are all  
connected to said local area network and are arranged to communicate with each other over said  
local area network.

3. The contact center of claim 2 wherein the first switching apparatus is configured so that  
capacity utilized to communicate with others of said first switching apparatus is not used to  
communicate with said contact center resources.

4. The contact center of claim 2 wherein each of said first switching apparatus is connected to  
a prescribed set of trunks, and wherein there is a number M of additional first switching apparatus  
that are not connected to said trunks, and wherein said center is arranged to detect the failure of any  
one of said first switching apparatus connected to said trunks and to reroute said prescribed trunks

to one of said M first switching apparatus upon detection of such failure.

5. The contact center of claim 4 wherein M is 1.

5 6. A contact center comprising:

10 a plurality of switches, each of said switches being configured to interface contact center resources to a public network to facilitate the processing and servicing of contacts, each of said switches also being configured to interface with others of said switches, the communications capacity within each switch used to communicate with others of said switches being separate from and unusable as the capacity used to connect resources to the public network.

15 7. A contact center comprising a PBX connected to a plurality of contact center agent stations and to a switching apparatus, the PBX causing the contact center agent stations to be in communications with the switching apparatus, the switching apparatus also being in communications with other contact center agent stations over a local area network, the functionality implemented by connecting the switching apparatus to the agents via the PBX being the same as the functionality implemented by connecting the switching apparatus to the agents via the local area network.

20 8. A contact center comprising a plurality of switching apparatus for routing contacts from a public network to contact center resources, a subset of the switching apparatus being assigned a plurality of communications channels for interfacing with a public network,

at least one backup switching apparatus, and

means for detecting when one of the switching apparatus is faulty, and for rerouting channels normally serviced by the faulty switching apparatus to a backup switching apparatus for service, the backup apparatus being configured to service any of the faulty switching apparatus which is detected as failing.

9. A method of expanding a contact center's capacity and adding agents comprising the steps of:

connecting additional agents to a switching means through a PBX until the PBX runs out of capacity and then connecting additional agents to the switching means over a local area network.

10. The method of claim 9 wherein the local area network is an ATM switch.

11. The method of claim 10 wherein the local area network is an Ethernet.

12. A switching arrangement for connecting contacts to agents for servicing such contacts in a contact center, the switching arrangement comprising:

a PBX, the PBX having a plurality of ports, each port being connected to a separate agent terminal and having a separate PBX extension,

a switch connected to a public network and to the PBX, the switch including a plurality of switch ports and means for permanently connecting each agent to a separate switch port by dialing the PBX extension of the agent connected to said switch port, and

means for routing each contact through the switch and PBX from the public network to an agent, and for servicing the contacts, irrespective of the type of contact.

13. The switching arrangement according to claim 12 wherein said switch includes means for allowing agents to logon or register, and wherein upon said logon or registration, said switch dials an agent through said PBX and maintains a connection from said switch to said agent through said PBX.

14. A contact center comprising a plurality of agent terminals, each connected to a PBX, the PBX having a plurality of ports for connection to a public network, all of such ports being connected to a second switching arrangement, the second switching arrangement and the agent terminals also being in communication via a local area network.

15. The switch of claim 12 further comprising means for maintaining a connection to an agent while performing at least one of the following telephony functions: hold, transfer, conference, record, playback.

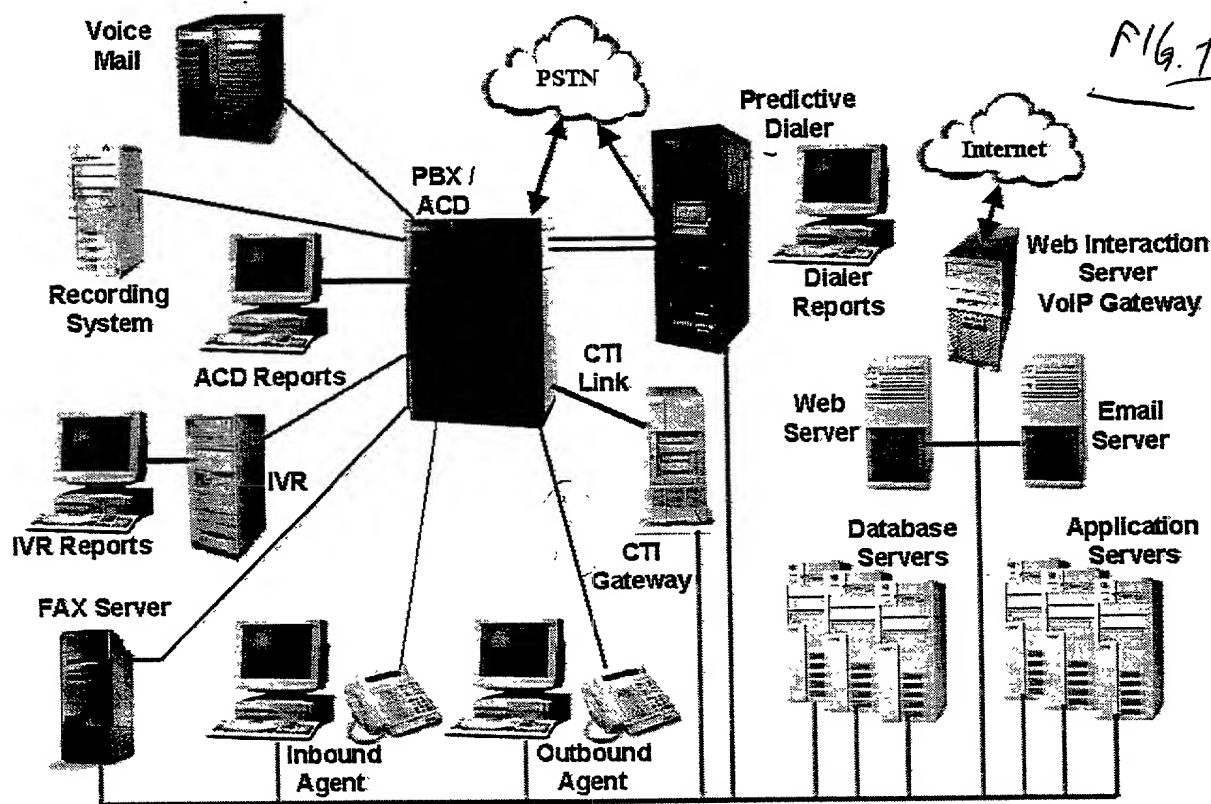
## ABSTRACT

An improved call center architecture includes a switch which communicates with agents either over a broadband network or through a conventional legacy PBX. The hybrid configuration also includes N+1 fault tolerance and the ability to linearly expand the capacity of the system by simply adding new switching chassis.

In upgrade environments, CCPRO is installed next to an existing PBX or ACD to preserve the investment in the switch and cabling while offering enhanced capabilities and a lower cost of ownership. CCPRO replaces numerous and disparate systems with one comprehensive solution.

In a traditional call center, the PBX or ACD, predictive dialer, IVR, voice mail, recorded announcement devices, fax servers, recording systems, data networking equipment and servers are all separate and distinct components that must be integrated to meet the needs of the call center. Many of these components are based on proprietary architectures, which leads to very high integration, capital and ongoing operating costs. Web interaction servers are the latest generation of component call center equipment that needs to be integrated into a call center solution. CCPRO incorporates all of these functions into a single, comprehensive product.

### Legacy Call Center Configuration



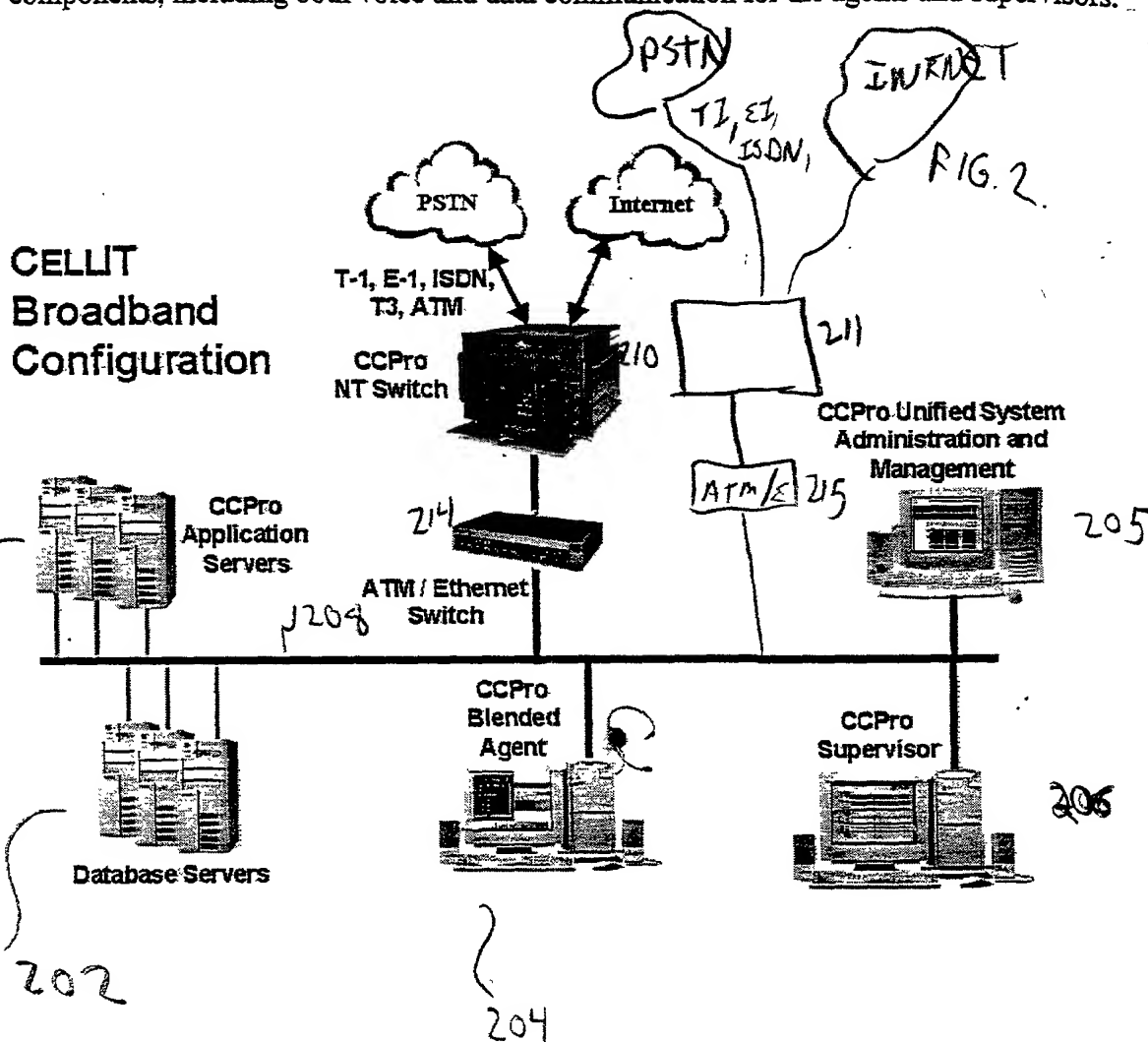
Reports in a typical call center must be pulled from disparate sources. There is no single database from which a report detailing inbound, outbound, IVR and/or faxing activity can be generated. A call center may attempt to approximate a blended solution by having agents logged into an inbound ACD for some portion of the day and having the same agents logged into an outbound predictive dialer for other portions of the day. Under this scenario, however, there is no easy way to generate a single report that would summarize billing and agent productivity, and it is difficult to dynamically adjust inbound / outbound ratios based on call patterns and service levels.

*The CCPRO solution greatly simplifies and reduces the complex combination of hardware and software found in the typical call center.*

New Installations

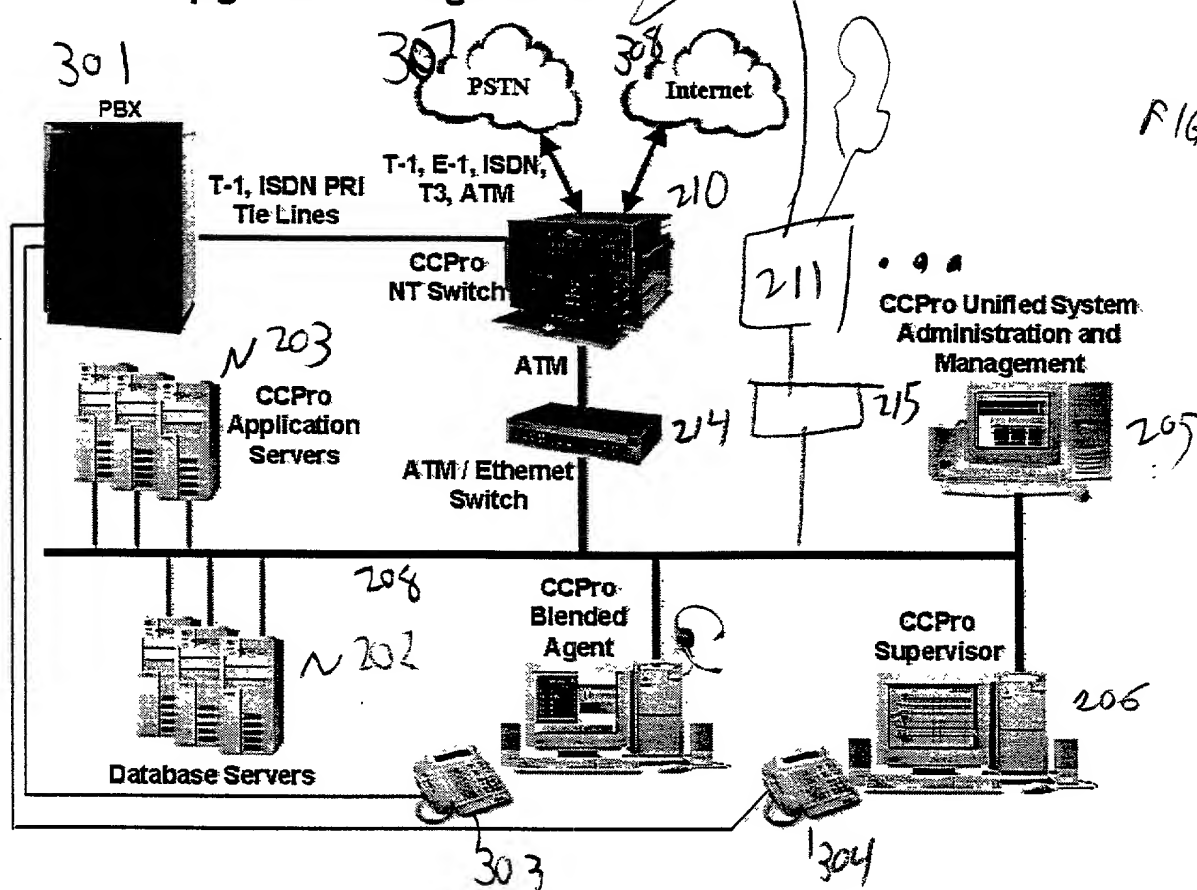
CCPRO is also a superior solution for greenfield installations. ATM or TCP/IP connections to agent and supervisor desktops offer superior value and performance. Cost savings accrue by replacing not only the peripheral call center equipment, but also the PBX or ACD itself with CCPRO. A single ATM or ethernet network is used to integrate the various CCPRO contact center components, including both voice and data communication for the agents and supervisors.

CELLIT  
Broadband  
Configuration





## CELLIT Upgrade Configuration



CCPRO uses the existing switch fabric by establishing a connection between itself and the agent through the legacy switch. CCPRO then manages the agent interaction to perform the various contact center functions. Significantly, CCPRO does not require a CTI (computer telephony integration) link into the existing PBX or ACD. Not only are the CTI links themselves expensive for many switches, but older installed switches often need extensive hardware and software upgrades to support the links.